means based upon either first 32° F. minimum or first radiation and means based upon first advection are not so great as in the spring.

Mean length of the potential growing season (defined as the number of days between last spring and first fall advection frost) is from 15 to 32 days longer than the 32° F. minimum-based definition of growing season.

The number of radiation frosts intervening between last spring or first fall radiation frost and their associated seasonal advection frost varies greatly from year to year. Generally mean numbers are greater in spring than in fall and greater in the western than in the eastern part of the State.

The mean number of days between the last two frost events in spring and first two in fall, when last spring and first fall frosts are radiation-induced, ranges from 4 to 10 according to season and location.

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Weather Note

AN UNUSUAL HAIL FORMATION

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1. DESCRIPTION OF HAILSTONES

Dr. Freier made photographs and a drawing of some unusual hailstones that fell on St. Paul., Minn., on Saturday afternoon, June 23, 1962. He brought them to me for a meteorological explanation of the phenomenon which, I am afraid, is beyond my capabilities. The structure of the stones is so symmetrical as well as unusual that it seemed worthwhile to record the phenomenon in the hope that this bit of order may eventually aid the understanding of the process of hail formation.

The hailstones arrived at the ground with the greatest dimensions about 1.5 in., but were disc shaped with a depth approximately ⅓ the lateral extent (fig. 1 is an idealized sketch of the configuration of the stones). The center of the hailstone appeared to be a normal milky rounded hailstone. Surrounding this cloudy center there was one or more unusually broad rings of clear ice [1] and surroundings these rings (or ring) was a rim of symmetrically arranged normal milky hailstones. Figures 2 and 3 are photographs of the hailstones at successive stages of melt. The rim of spherical hailstones is particularly clear in the melting stone shown by the arrow in figure 3.

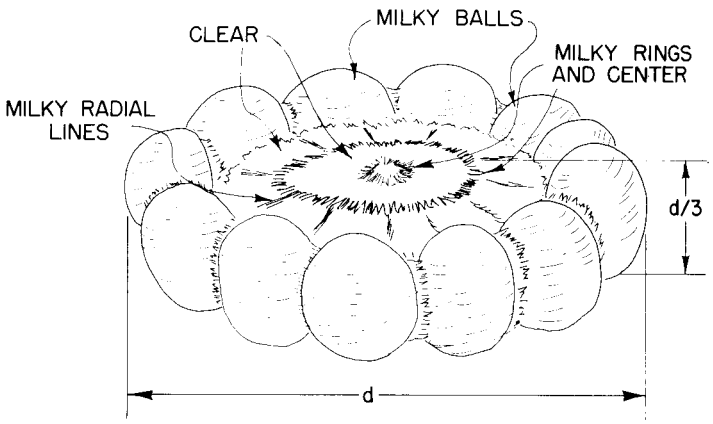

FIGURE 1.—Schematic sketch of hailstone structure.

[1] Clear ice presumably can form only from the freezing of supercooled raindrops from which the air has been removed from solution. Since such freezing is very inefficient, a clear layer 5 mm. thick must require an unusually long path in a cloud of supercooled drops.

FIGURE 2.—Hailstones collected in St. Paul, Minn., a few minutes after the storm.

FIGURE 3.—Hailstones after some melting had occurred.

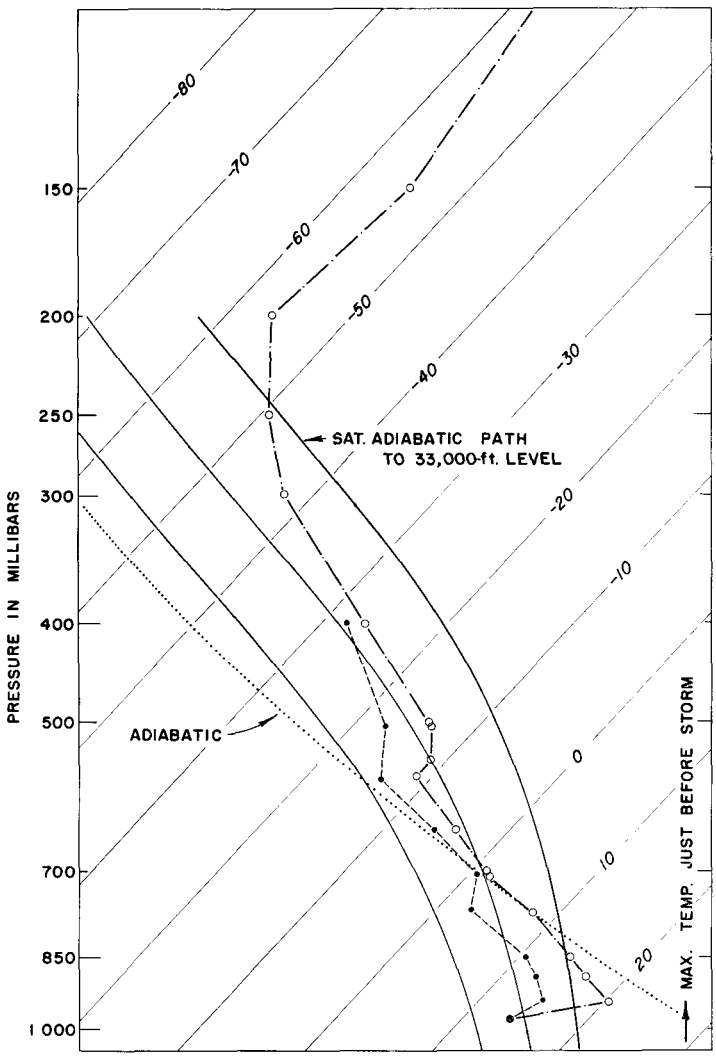

FIGURE 4.—Radiosonde ascent at St. Cloud, Minn., on the morning before the storm, 1200 GMT, June 23, 1962. The wet bulb curve and saturated adiabatic paths are shown with the temperature sounding. The saturated adiabatic path that intersects the sounding at 33,000 ft. has been emphasized.

2. DISCUSSION OF THE METEOROLOGICAL SITUATION

There were numerous strong reflecting cells reported by the Weather Bureau radar at the Minneapolis-St. Paul airport during the afternoon of June 23, and there were numerous reports of hail damage throughout the State, primarily north of the station. No front was analyzed on the surface map in Minnesota, but a north-south trough from a Canadian low center passed through the State on Saturday afternoon and most of the precipitation occurred just ahead of the trough line. The particular cell from which the hail fell was tracked by the Weather Bureau radar which reported a strong echo with a top at 33,000 ft. (maximum top of other nearby echoes was 38,000 ft.) at 1343 CST just about the time hail began falling on St. Paul. The storm cell moved eastward across the northern border of St. Paul and the area of hail was rather narrow and, as perhaps is common, the area of heavy hail was very sharply defined. There were cases on some of the east-west streets where on one side of the street large numbers of leaves and branches were broken from the trees and on the other side relatively little damage was done. The morning sounding at St. Cloud on the day of the storm is shown in figure 4. The stability index would be classed as only moderately unstable although there is a fairly deep layer of convectively unstable air. The saturated adiabatic path from 33,000 ft. is sketched to emphasize the importance of destabilizing factors which must have occurred after the sounding was made.